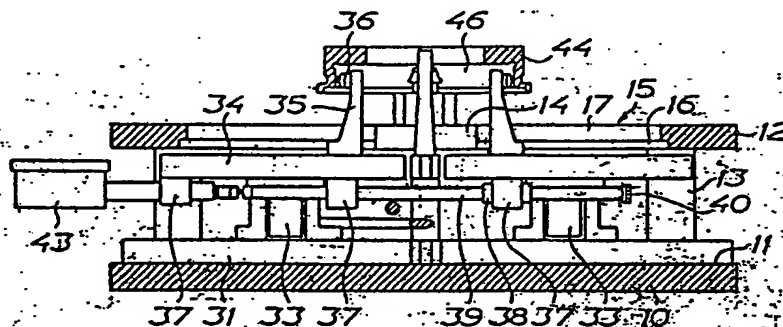


(51) International Patent Classification: G01B 5/12	A1	(11) International Publication Number: WO 79/00291 (43) International Publication Date: 31 May 1979 (31.05.79)
(21) International Application Number: PCT/SE78/00075 (22) International Filing Date: 13 November 1978 (13.11.78) (31) Priority Application Number: 7712827-0 (32) Priority Date: 14 November 1977 (14.11.77) (33) Priority Country: SE	(71) Applicant: FORSMAN, Lars, Östen; Lindögatan 1, S-253 72 Helsingborg, Sweden. (72) Inventor: Applicant is also the inventor. (74) Agents: STRÖM, Tore; GULLIKSSON, Jonas; Ström & Gulliksson AB, Rundelsgatan 14, S-211 36 Malmö, Sweden. (81) Designated States: CH (European patent), DE (European patent), FR (European patent), GB (European patent), JP, US. Published with: International search report	

(54) Title: APPARATUS FOR INDICATING INSIDE DIMENSIONS



(57) Abstract

An apparatus for indicating inside dimensions comprises a base plate (11) and a supporting plate (12) spaced above the base plate for the object to be measured. Aligned rails (34) displaceable in relation to each other are provided on the base plate (11) and extend along slots (15) in the supporting plate (12), said slots extending radially in relation to a centre. Measuring arms (35) project upwards from the rails (34) through the slots (15) which also form guides for securing supports for the object to be measured on the supporting plate (12). The rails are operatively connected to indicating members (43) for transmitting measuring motion from the measuring arms to the indicating members.

APPARATUS FOR INDICATING INSIDE DIMENSIONS

The invention relates to an apparatus for indicating inside dimensions comprising a base plate and a supporting plate spaced above the base plate for the object to be measured, said supporting plate having a plurality of guides extending radially in relation to a centre, for securing supports on the supporting plate in optional positions along the guides, said supporting plate forming at least one slot for passing through measuring arms projecting from below, rails which are displaceable in the longitudinal direction thereof and are operatively connected to an indicating member, being provided below the supporting plate along the slots for securing the measuring arms on the rails from above through the slots in optional positions and optional number.

Several embodiments of this kind of apparatus are previously known and a common feature thereof is that they either allow only inside measurements to be made or that they require an individual set up of the entire apparatus for different objects to be measured and/or for different dimensional ranges as far as congruent objects are concerned.

The purpose of the invention is to improve the apparatus referred to above in such a way that the apparatus can be broadly used and can be set up to be adapted to practically every existing measuring situation. In this connection the invention is based on the principles disclosed in the Swedish patent application 7513098-9; the elements described in said application can be used as operative elements in the apparatus according to the invention.

In accordance with said purpose, the invention



provides an apparatus of the kind referred to above which is characterized in that the guides for the supports are arranged as through diametrical slots in the supporting plate, the measuring arms projecting upwards through the slots, and that aligned rails located on the same diametrical line and displaceable in relation to each other are arranged as units transmitting measuring motion between the measuring arms and the associated indicating members for indicating inside dimensions as well as conditions relating to form, direction and position along different coordinates with the units transmitting measuring motion in unchanged relationship to the associated indicating members.

In order to explain the invention, this will be described below, reference being made to the accompanying drawings disclosing examples of the apparatus according to the invention and wherein

FIG. 1 is a plan view of the apparatus set up for measuring an object;

FIGS. 2 to 5 are cross-sectional views taken along lines II-II, III-III, IV-IV and V-V in FIG. 1;

FIGS. 6 and 7 are plan views of the base plate and the support plate, respectively; and FIG. 8 is a fragmentary vertical sectional view illustrating supports and measuring arms of alternative embodiments and in alternative positions.

The apparatus comprises a base plate 10 having a face-ground upper side 11, and a supporting plate 12 which also has a face-ground upper side, said supporting plate being mounted by means of a number of standards 13 arranged as spacers to space the supporting plate above the face-ground upper side of the

base plate, the supporting plate being plane-parallel with the base plate. In the supporting plate there is formed a central circular opening 14, a number of slots 15 extending diametrically from said opening.

5 These slots are formed as T-formed undercut slots having a wider lower portion 16 and a narrower upper portion 17, and locating members 21 can be secured in the slots in optional position therein by means of yokes 18 having a screw threaded bore, and screws
10 19 which are screwed into the bores, said screws having a hexagonal socket and an annular flange or washer 20. Each locating member has an elongated slot 22 forming a shoulder 23 engaged by the washer or flange 20, and has at one end thereof a cylindrical
15 through bore 24 accurately dimensioned, in which there can be secured a support 25 of optional length and optional type, FIGS. 3 to 5, or a guide socket 26, FIG. 5, in which a rod 27 for transmitting measuring motion is guided with accurate sliding fit,
20 said rod having a measuring probe 28 at one end and a measuring abutment 29 at the other end thereof. The support 25 and the guide socket 26 are fixedly secured by means of a radial set screw (not shown). The support has opposite plane surfaces 30 against
25 which the set screw can be set in order to locate the support in a predetermined rotated position. Each support has at the upper end thereof a head 25' of hardened steel, which widens from top to bottom thereof and at the bottom has an annular bead 25''.
30 The support 25 may be formed, if desired, with a through axial bore in order to be used also as a guide socket, the separate guide sockets 26 thus being dispensed with, or alternatively the guide sockets 26 may fulfil the same function as the
35 supports, the latter being dispensed with. The locat-

ing members 21 may be provided in optional number and optional positions with or without support or guide socket to the extent and in the manner called for by the measurements to be performed on a certain object.

On the base plate 12 rails 31 can be secured, for example rails of the composite type disclosed in the Swedish patent application 7513098-9. The rails can be secured by means of screws which are screwed from the upper side of the base plate 10 into threaded holes in the base plate such holes two of which are shown at 32, being provided in the base plate 10 in the same pattern as the slots 15. On each rail 31 there can be provided in optional position linear anti-friction guides 33 for example of the type disclosed in said patent application, and two aligned rails 34 of the same type as the rails 31 are mounted on said anti-friction guides and extend along the rails 31. The rails 34 can be displaced over a limited distance in the longitudinal direction thereof in parallel with the rails 31 and in the same vertical plane as these. The rails 34 thus extend below the supporting plate 12 along a slot 15 therein, and the rails of each pair are biased away from each other by means of springs in the anti-friction guides.

Measuring arms 35 can be mounted on the rails 34, such arms projecting perpendicularly from the rails and extending through one of the slots 15 or through the central circular opening 14. They can also pass through the slot 22 in one of the locating members 21. The measuring arms can be located in an optional position on the rails 34, and they are mounted from above by means of screws screwed into a nut engaging an undercut groove in the rail, e.g.

in the manner described in the Swedish patent application 7513098-9. At the upper end thereof the measuring arms can be provided with measuring probes 36 of different types which as far as type and length are concerned are adapted to the object to be measured in the apparatus.

The rails 34 are provided on the lower side thereof with holders 37 projecting laterally from the rails. In the holder of one of two rails aligned diametrically there is secured an internally threaded socket 38, preferably slotted, a push rod 39 being screwed into said socket. The axial position of the push rod can be adjusted by screwing the rod in the socket 38 at an hexagonal socket 40 at one end of the rod, an abutment 41 being provided at the other end. The push rod 39 extends with guiding clearance fit through a holder 37 on the other one of said two rails to engage the plunger 42 of a measuring gauge 43 at the abutment 41. The gauge 43 is mounted in a holder 37 on said other rail 34 and has the dial thereof located outside the supporting plate 12.

On the base plate there are provided three units for transmitting measuring motion of the kind described above each having two rails 34 aligned diametrically and supported by the anti-friction guides 33 on a common rail 31 which is fixedly connected to the base plate. A push rod 39 adjustably mounted on one of the rails 34 cooperates with a measuring gauge 43 on the other one of the two rails 34. These three units transmitting measuring motion extend along lines II-II, III-III and IV-IV in FIG. 1. The aggregates along lines II-II and IV-IV are perpendicular to each other while the unit along line III-III forms an angle of 30° to the unit along line II-II. Moreover, a rail 31 is provided on the support-



ing plate along line V-V and this too forms an angle of 30° to line II-II in FIG. 1.

The apparatus according to the invention can be set up in several manners for indicating simultaneously several dimensions of an object to be measured, and in this connection it is an important advantage that the set up can take place entirely from the upper side of the supporting plate 12 without the necessity to touch at all the units transmitting measuring motion below the supporting plate apart from a fine adjustment of the push rod 39 at the socket 40 as may be necessary in order to set the associated gauge 43 to zero. In FIGS. 1 to 5 such a set up of the apparatus is shown for measuring an object 44 which is cylindrical and has a through central opening having three circular portions 45, 46, and 47 of different diameters.

For the location of the object 44 on the supporting plate 12 there are secured to this plate four locating members 21 having supports 25 in a suitable position in order that the heads 25' of the supports shall guidingly engage the inner side of the opening portion 46 at the annular bead 25''.

Measuring arms 35 having probes 36 are mounted on the unit transmitting measuring motion, which extends along line II-II - see FIG. 2 - for indicating the inside diameter of the opening portion 46, and in order to make such measuring possible no locating members and associated supports are arranged along the line II-II.

Measuring arms 35 having probes 36 are mounted on the unit transmitting measuring motion, which extends along line III-III - see FIG. 3 - for indicating the inside diameter of the opening portion 47. Along this line III-III a locating member 21 is

arranged having a support 25 one probe 36 extending upwards through the slot 22 in the locating member; as will be seen this probe can be located close to the adjacent support 25. One and the same slot 15 in the supporting plate 12 is used for passing through one of the probes 36 and for mounting the locating member.

Finally, measuring arms 35 having probes 36 are mounted on the unit transmitting measuring motion, which extends along line IV-IV - see FIG. 4 - for indicating the inside diameter of the opening portion 45.

In order that the units transmitting measuring motion which cross each other shall not interfere with each other the rails 31 on the base plate must of course be interrupted at the centre of the apparatus; otherwise they could not be positioned at a common level. Moreover, the push rods must be located at different levels so that they can cross each other freely, which is achieved by the holders 37 having the centres thereof in different planes.

Thus, it is possible to obtain information of three different inside diameter dimensions of the object being measured by positioning this object once in the apparatus.

It should be noted that inaccuracies in the position of the object to be measured in the apparatus such as this position is determined by the supports 25, do not cause inaccuracies in the measurement. because the two probes for each measuring function are floatingly mounted in the apparatus by means of the units transmitting measuring motion below the supporting plate 12.

In FIG. 5 the use of the rails 31 along the line V-V is disclosed in connection with the set up of the



apparatus for measuring an axial dimension of the object 44 to be measured. A rocker type transmitter 48 is mounted by the same screw 19 as the locating member 21 on the lower side of the supporting plate 12 and comprises a bell crank 49 accurately mounted which is biased by a spring 50 towards an abutment 51. The bell crank has probes 52 which cooperate with the abutment 29 on the rod 27 and with an abutment 53 on a push rod 54, respectively, said push rod cooperating at an abutment 55 at the other end thereof with the probe 42 of a measuring gauge 43. The probe 28 of the rod 27 will engage the bottom of the opening portion 46, when the object to be measured is laid down to engage the locating members 21, and thus there is obtained an indication of the inside height of the object from the edge abutting the locating members to the bottom of the opening portion 46.

A further advantage of the apparatus described in addition to the several possible combinations which are obtained by arranging the apparatus according to the invention, is to be seen in the fact that many of the elements used in the apparatus can be of the same construction as that included in the unit for transmitting measuring motion according to the Swedish patent application 7513098-9. Thus, it is possible to combine the apparatus with a vertical plate having grooves wherein such units can be mounted for measuring outside diameter dimensions or axial dimensions at the same time as the inside dimensions are being measured in the manner described.

FIG. 8 shows supports of a type which can easily be adapted to objects of different forms and sizes and also can be arranged in such a way that they form axial abutments and protection for the measuring

probes. Each support comprises a standard 25 which is secured in the bore 24 of the locating member 21 and at the upper end thereof has a head 125' having an annular bead 125'', the head forming a diametrical slot so that it can be secured by screws in different displaced positions on the standard to provide support at positions which are differently spaced from the centre of the standard. In FIG. 8 different adjusted positions of the head 125' are shown. The head of the central support and of the support to the right in the figure also form a protection over a measuring arm 35 and a measuring probe 36, respectively, positioned adjacent to the support, in order to avoid that the probe which is relatively sensible is being damaged when the object to be measured is brought to the measuring position in the apparatus.

In the embodiment shown the indication of the dimensions is purely mechanical but the measuring gauges can also be replaced by electric or pneumatic transmitters for indication on separate instruments.

The apparatus can be used for indicating not only inside diameters or longitudinal dimensions but also for indicating conditions relating to form, position and direction. In that case the measurement is performed between one or more supports 25 provided as fixed references, and measuring arms 35 and probes 36, respectively, indicating in relation to said supports. The same method can be used as that applied in prior art apparatus for indicating inside dimensions but the advantage obtained by the apparatus described herein is that this measuring function can be combined with other measuring functions and can be performed simultaneously therewith.

CLAIMS

1. An apparatus for indicating inside dimensions comprising a base plate (10) and a supporting plate (12) spaced above the base plate for the object (44) to be measured, said supporting plate having a plurality of guides (15) extending radially in relation to a centre, for securing supports (21, 25) on the supporting plate in optional positions along the guides, said supporting plate forming at least one slot (15) for passing through measuring arms (35) projecting from below, rails (34) which are displaceable in the longitudinal direction thereof and are operatively connected to an indicating member (43), being provided below the supporting plate (12) along the slots (15) for securing the measuring arms (35) on the rails from above through the slots in optional positions and optional number, characterized in that the guides for the supports (21, 25) are arranged as through diametrical slots (15) in the supporting plate (12), the measuring arms projecting upwards through the slots, and that aligned rails (34) located on the same diametrical line and displaceable in relation to each other are arranged as units transmitting measuring motion between the measuring arms and the associated indicating members for indicating inside dimensions as well as conditions relating to form, direction and position along different coordinates with the units transmitting measuring motion in unchanged relationship to the associated indicating members.

2. An apparatus according to claim 1, characterized in that one of the two rails (34) positioned below slots (15) which are aligned diametrically is operatively connected, by

11

means of a push rod (39), with the indicating member (43) on the other rail.

3. An apparatus according to claim 2, characterized in that the push rod (39) is adjustable axially in relation to said one rail (34).

4. An apparatus according to any of claims 1 to 3, characterized in that each support (21, 25) comprises a member (21) to be secured to the upper side of the supporting plate and having a through opening (22) for the passage of measuring arms (35).

5. An apparatus according to any of claims 1 to 4, characterized in that each support (21, 25) comprises a standard (25) having a head (25') at the top for axial and/or radial engagement with the object (44) to be measured.

6. An apparatus according to claim 5, characterized in that the standard (25) is formed as a socket having a through axial bore.

7. An apparatus according to claim 5 or 6, characterized in that the head (25') is adjustable transversely of the standard (25).

25



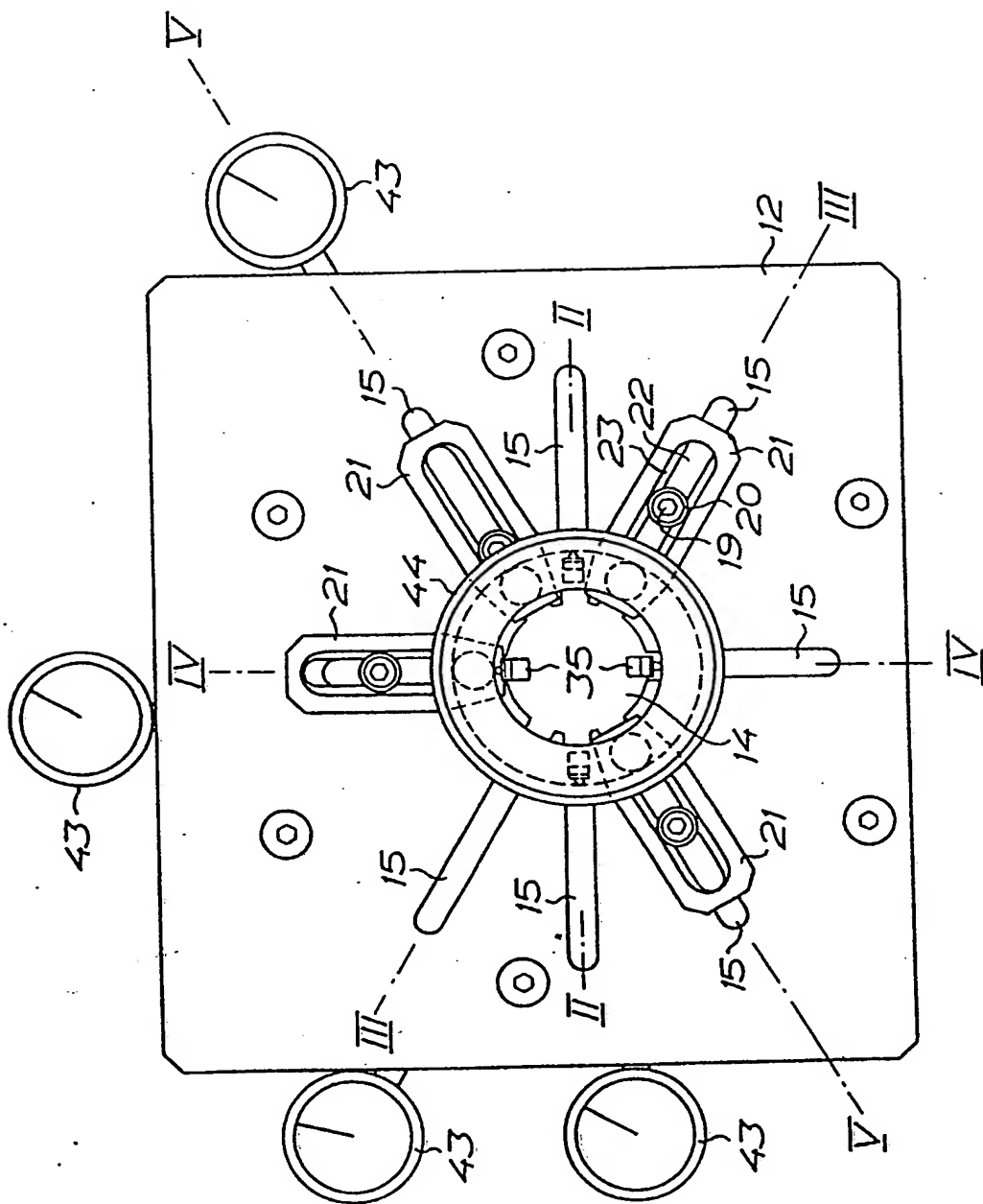


FIG. 1

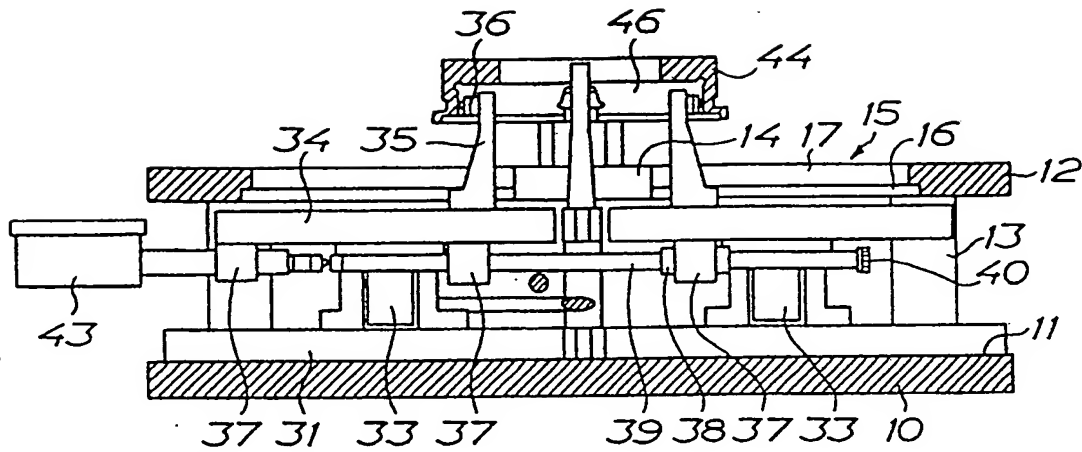


FIG. 2

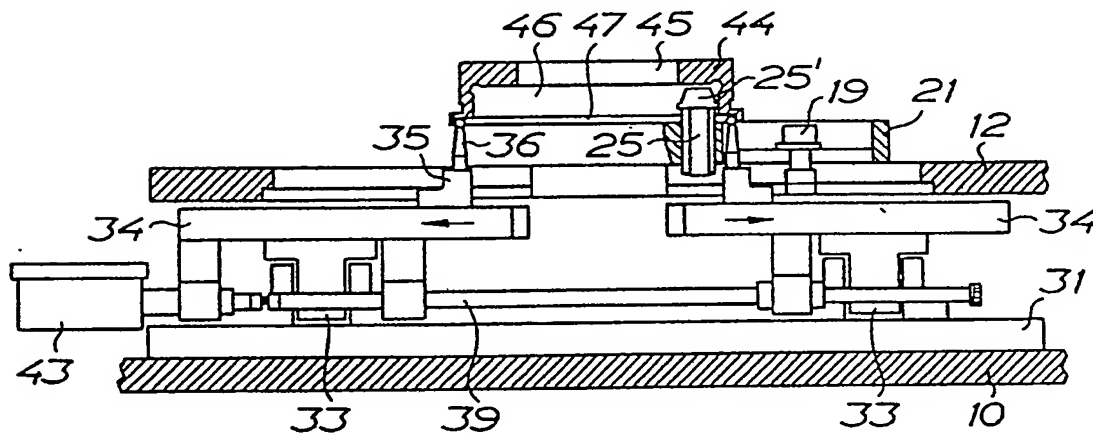


FIG. 3

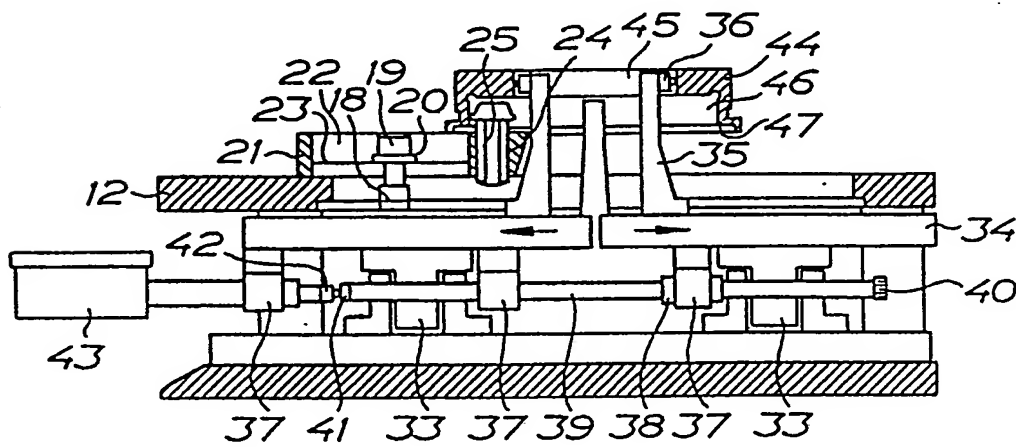


FIG. 4

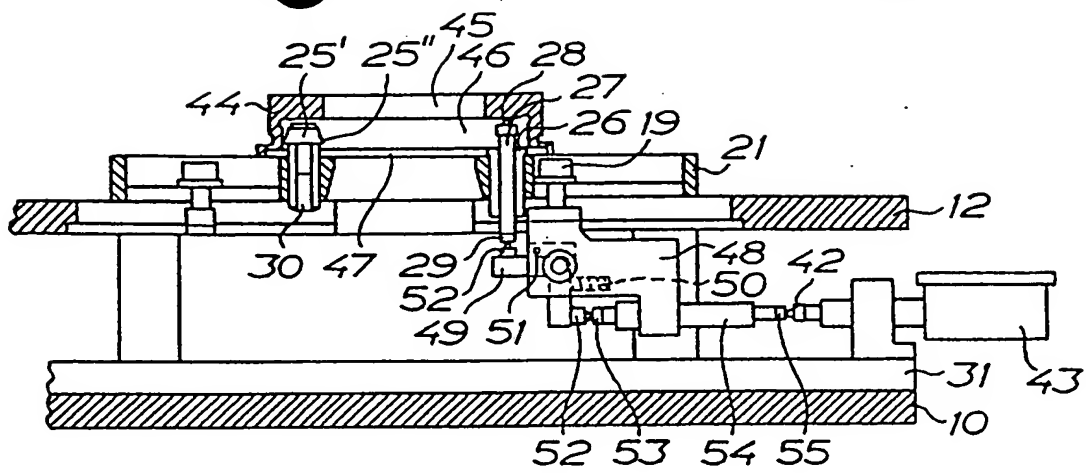


FIG. 5

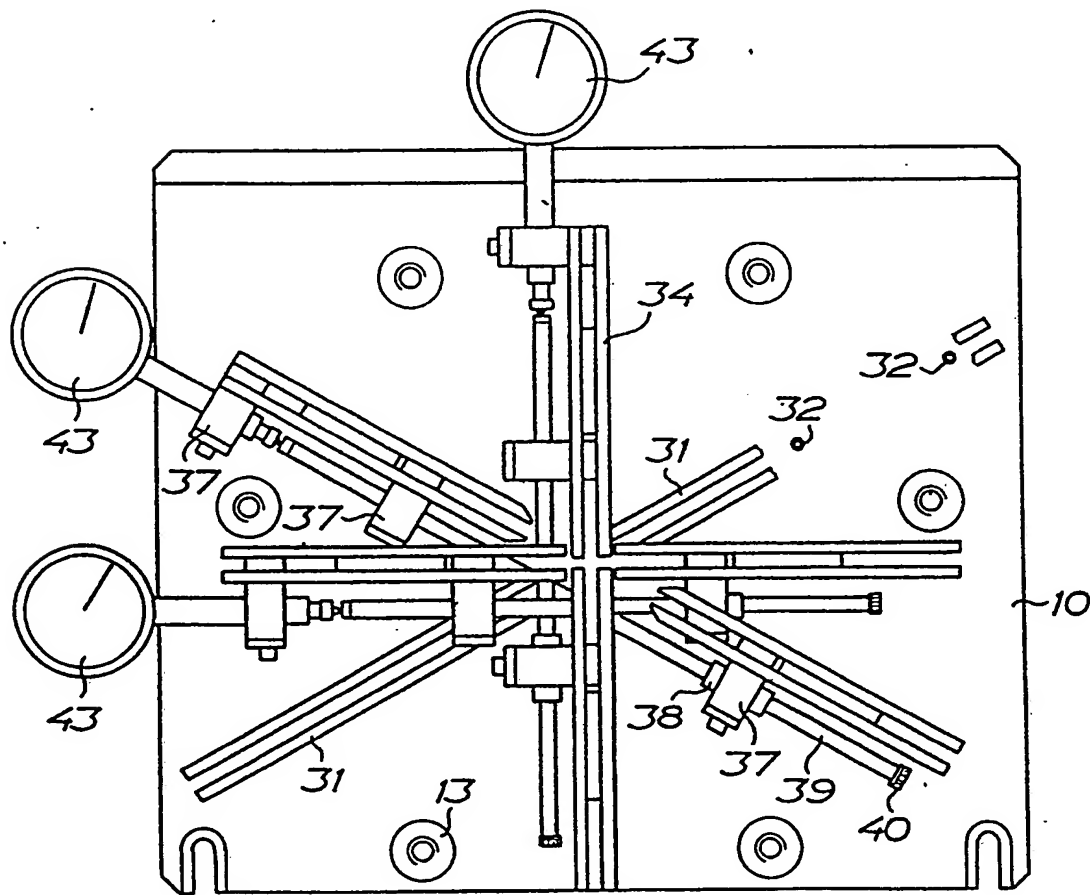
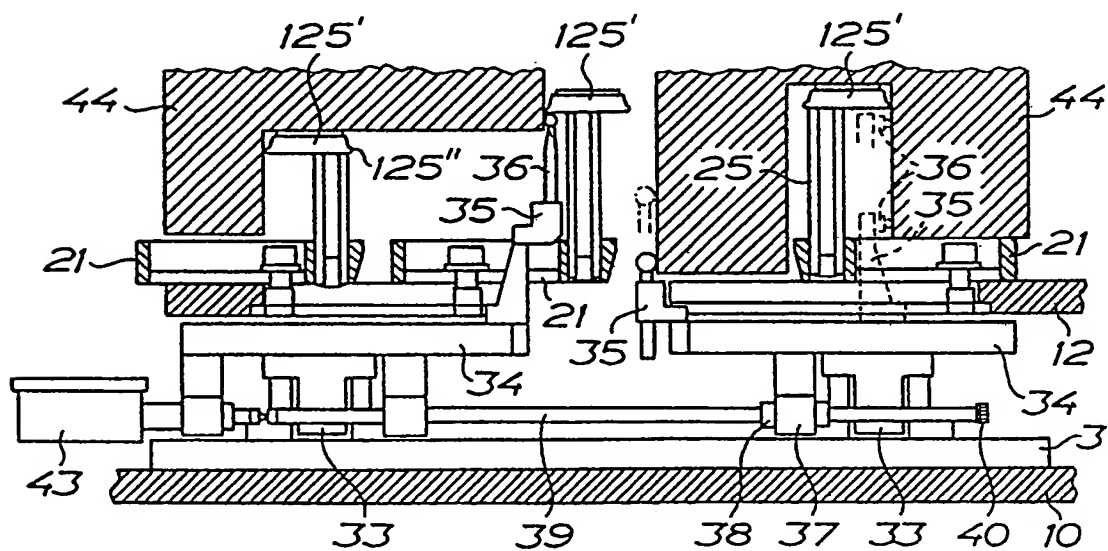
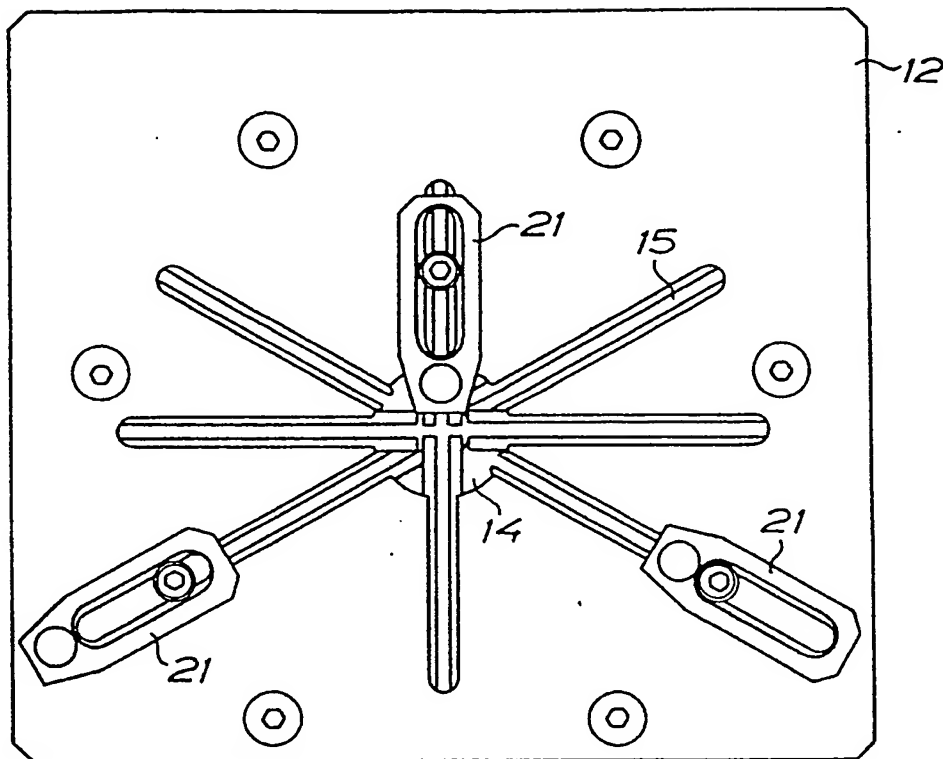
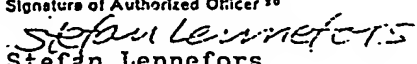


FIG. 6



INTERNATIONAL SEARCH REPORT

International Application No PCT/SE78/00075

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ³		
According to International Patent Classification (IPC) or to both National Classification and IPC		
G 01 B 5/12		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁴		
Classification System	Classification Symbols	
IPC 2	G 01 B 3/00, 5/00, 5/08, 5/12, 5/20 .../...	
Documentation Searched other than Minimum Documentation to the extent that such documents are included in the fields searched ⁵		
SE, NO, DK, FI classes as above		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴		
Category ⁶	Citation of Document, ¹⁵ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸
A	US, A, 2197198 published 1940, April 16, H Frauenthal	1
A	FR, A5, 1090408 published 1955, March 30, Carossino Frères	1
A	FR, A6, 66276 published 1956, June 28, Société Carossino Frères	1
<p>¹⁴ Special categories of cited documents: ¹⁴</p> <p>"A" document defining the general state of the art</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document cited for special reason other than those referred to in the other categories</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but on or after the priority date claimed</p> <p>"T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search ¹	Date of Mailing of this International Search Report ²	
1979-01-08	1979-01-09	
International Searching Authority ¹	Signature of Authorized Officer ¹⁹	
Swedish Patent Office	 Stefan Lennefors	

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

II Continuation classification system.
 Deutsche Klassen: 42b:22/03, 26/03
 US classification: 33/147, 178, 180

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹⁰

This International search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers _____, because they relate to subject matter ¹¹ not required to be searched by this Authority, namely:
2. ☐ Claim numbers _____, because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out ¹², specifically:

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ¹¹

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☐ FADED TEXT OR DRAWING
- ☒ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☒ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.

THIS PAGE BLANK (USPTO)